Global Environmental Change 54 (2019) 31–39

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Attribution matters: Revisiting the link between extreme weather experience and climate change mitigation responses

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ARTICLE INFO

Keywords:
Climate change
Experience
Attribution
Risk perception
Extreme weather

ABSTRACT

The literature suggests that extreme weather experiences have potential to increase climate change engagement by influencing the way people perceive the proximity and implications of climate change. Yet, limited attention has been directed at investigating how individual differences in the subjective interpretation of extreme weather events as indications of climate change moderate the link between extreme weather experiences and climate change attitudes. This article contends that subjective attribution of extreme weather events to climate change is a necessary condition for extreme weather experiences to be translated into climate change mitigation responses, and that subjective attribution of extreme weather to climate change is influenced by the psychological and social contexts in which individuals appraise their experiences with extreme weather. Using survey data gathered in the aftermath of severe flooding across the UK in winter 2013/2014, personal experience of this flooding event is shown to only directly predict perceived threat from climate change, and indirectly predict climate change mitigation responses, among individuals who subjectively attributed the floods to climate change. Additionally, subjective attribution of the floods to climate change is significantly predicted by pre-existing climate change belief, political affiliation and perceived normative cues. Attempts to harness extreme weather experiences as a route to engaging the public must be attentive to the heterogeneity of opinion on the attributability of extreme weather events to climate change.

1. Introduction

One of the main ways climate change is perceived is through changes in extremes that lie beyond the bounds of previous weather (Trenberth, 2012). Indeed, people often infer the evidence for climate change from perceived weather anomalies (Borick and Rabe, 2014; Egan and Mullin, 2012; Howe and Leiserowitz, 2013), and multiple studies have linked extreme weather experiences with the perceived risk of dangerous climate change and willingness to act pro-environmentally (Haden et al., 2012; Spence et al., 2011; van der Linden, 2014a). These observations have commonly been invoked to support a view that extreme weather experiences have potential to foster climate change engagement[1] by influencing the way people perceive the reality, immediacy and implications of climate change (McDonald et al., 2015).

Research in psychology suggests that exposure to extreme weather can inform climate change perceptions through experiential processing; whereby negative affective responses to impacts from adverse weather are intuitively associated with climate change and salient memories of experiencing such impacts contribute to heightening perceived risk from climate change (Marx et al., 2007; Weber, 2006). People typically rely on experiential processing in judging risks because deliberative analytical processing of statistical risk information requires more cognitive effort and occurs less automatically (Myers et al., 2013; Weber, 2006). Although there is mixed evidence about people's ability to accurately detect changes in local climatic trends (Brody et al., 2008; Hamilton and Keim, 2009; Howe and Leiserowitz, 2013; Marlon et al., 2018), extreme weather events may operate as climate change 'signals' that heighten risk perception by increasing the salience of climate change, triggering concern and making future climatic events more imaginable (Demski et al., 2017; Renn, 2011).

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[1] Climate change engagement is defined here as the constellation of cognitive, affective and behavioural indicators of engagement including awareness, concern and motivation to act (Lorenzoni et al., 2007).

https://doi.org/10.1016/j.gloenvcha.2018.11.005
Received 7 March 2018; Received in revised form 2 November 2018; Accepted 11 November 2018
Available online 23 November 2018
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Yet, as many people understandably see extreme weather and climate change as separate issues, extreme weather experiences do not invariably affect climate change perceptions (Brulle et al., 2012; Whitmarsh, 2008). In the event of an encounter with extreme weather or perceived anomalous weather changes, there are a number of available narratives with which individuals may choose to make sense of their experience, including natural climatic variability, anthropogenic climate change and other exceptional incident possibilities (Reser et al., 2014). Unless the experience is explicitly deemed to be a manifestation of climate change, it is unlikely to significantly influence climate change perceptions (McCright et al., 2014; Reser et al., 2014). Logically, extreme weather must be perceived to be connected with climate change to have any relevance in informing climate change perceptions. While exposure to extreme weather may spontaneously update the perceived risk of subsequent adverse weather impacts (Frondel et al., 2017; Siegrist and Gutscher, 2006), more deliberate experience appraisal is required for extreme weather experiences to be interpreted in terms of climate change risk (Hamilton-Webb et al., 2017). In other words, extreme weather does not inherently signify climate change. Rather, a conscious *subjective* attribution of extreme weather to climate change operates as a necessary condition for extreme weather experiences to be marshalled into the constitution of climate change risk perceptions (van der Linden, 2014b).

To date, there has been limited investigation of the implications of individual differences in extreme weather attribution for the link between extreme weather experiences and climate change attitudes. Subjective attribution is typically subsumed under supposed measures of personal climate change experience (e.g., asking survey participants if they have personally experienced any "extreme weather conditions that they interpret as caused by long-term global climate change" [Blennow et al., 2012]) or implied in speculative interpretations of the link between extreme weather experiences and climate change attitudes (e.g., Demski et al., 2017). A few recent studies have tackled a proximate question regarding differences in the influence of objective and perceived weather patterns on climate change perceptions (Marlon et al., 2018; Shao, 2016; Shao and Goidel, 2016). However, the extent to which the subjective attribution of specific weather events to climate change plays a role in moderating the way experience of the events affect individual responses to climate change remains unclarified.

This article investigates the interaction between personal experience and subjective attribution of flooding in predicting climate change attitudes. 'Subjective attribution' is conceptualised here as a personal understanding that an extreme weather event is causally connected to climate change or is a sign of climate change. Using data from a national survey conducted following major flooding across the United Kingdom in winter 2013/2014, the analyses explore how subjective attribution moderates the relationship between flooding experience, perceived threat from climate change and climate change mitigation responses. The role of psychological and social factors, specifically climate change belief, political affiliation and perceived normative cues, as influences on subjective attribution is also examined.

2. Flooding experience and public responses to climate change in the UK

Large parts of the UK suffered exceptionally severe flooding in the winter of 2013/2014 (UK Met Office, 2014). Heavy rains combined with strong winds caused significant disruption to individuals, businesses and infrastructure. These events necessitated a national emergency response, and prompted then Prime Minister, David Cameron, to voice "suspicion" that the severe weather was linked to global climate change (BBC, 2014). Flooding is expected to be one of the main impacts on UK communities resulting from climate change (DoH, 2001), and climate scientists have since confirmed that anthropogenic warming significantly contributed to the 2013/2014 UK flooding (Schaller et al., 2016).

Shortly after the floods, researchers from two British universities conducted a national survey of climate change perceptions (Capstick et al., 2015; Pidgeon et al., 2016). They found that people who directly experienced the flooding were more likely to perceive their local area to be vulnerable to climate change impacts and view climate change as a threat to themselves and their family (Capstick et al., 2015). Additionally, most participants in the survey responded affirmatively to questions about the likelihood that the flooding may have been caused in part by climate change (64%), and that the floods demonstrated what can be expected from climate change in the future (72%). Interestingly, a greater proportion of participants indicated agreement (45%) than disagreement (33%) with a statement that: 'it is impossible to link a single weather event with climate change'; reflecting a level of ambivalence in the perceived attributability of the flooding to climate change. Further analysis of data from the survey revealed that climate change concern, negative emotional responses to flooding, and the personal salience of climate change, significantly mediated an indirect link between personal experience of the floods and intentions to engage in mitigation behaviour, as well as support for national climate policies (Demski et al., 2017).

However, evidence of a link between flooding experiences and climate change engagement in the UK had been mixed prior to the 2013/2014 flooding. In one national study, self-reported local flooding experience was shown to have an indirect positive link with preparedness to reduce energy use, and this link was mediated by perceived instrumentality (efficacy), concern and perceived local vulnerability to climate change (Spence et al., 2011). Conversely, a study conducted in southern England showed that flood victims reported no greater levels of concern or engagement in actions aimed at addressing climate change than non-flood victims (Whitmarsh, 2008). A more recent study also showed that, while there was a statistically significant link between flooding experience and climate change mitigation behaviours among a sample of UK farmers, these behaviours were not motivated by intentions to address climate change *per se* (Hamilton-Webb et al., 2016). There was a consensus across the latter two studies that personal values might play a stronger role than experience in determining individuals' responses to flooding and climate change.

The role of subjective attribution in Spence et al.'s (2011) findings is unclear, as participants in their study were not asked if they perceived their reported flooding experiences to be attributable to climate change. However, Whitmarsh (2008) and Hamilton-Webb et al. (2016) reported that climate change was the least frequently cited cause of flooding, compared with other factors such as poor watercourse maintenance, among participants in their studies. Given indications that extreme weather experiences are unlikely to instigate climate change mitigation action and policy support in the absence of a perceived connection with climate change (McCright et al., 2014; Reser et al., 2014), it is reasonable to consider the likelihood that individual differences in the subjective attribution of flooding to climate change may help explain the inconsistencies in the evidence for a link between flooding experience and climate change attitudes in the UK.

3. Conceptual framework and hypotheses

Human societies have historically sought to establish causes for their daily weather, and establishing culpability for adversity or personal affliction is often the first step towards overcoming or living with its effects (Hulme, 2014). One of the most common questions put to climate scientists in the aftermath of extreme meteorological events is: 'Was this weather event caused by climate change?' (Hulme, 2014; Stott and Walton, 2013). This line of questioning reflects public interest in determining if specific extreme weather events are consistent with patterns expected from climate change. Against a backdrop of increasing belief in *anthropogenic* climate change among the public (Harvey, 2015; Milfont et al., 2017), it also reflects an interest in determining if the incidence of extreme weather is linked to the

environmental impact of human activities. On these accounts, the attribution of weather extremes to climate change encapsulates the concretisation of climate change risk, and a validation of the moral and practical onus to act, in public consciousness.

Irrespective of objective physical events or scientific evidence, experiences of environmental conditions are subjectively interpreted (Demuth et al., 2016) and subjective weather interpretations are likely to be shaped by individuals' social and political context (Marlon et al., 2018). In this respect, perceptions of extreme weather events may be influenced by the reactions of institutional actors, such as politicians and the media (Cologna et al., 2017), as well as the reactions of other individuals with whom the perceiver has a personal connection. These reactions can exert a normative influence by signalling what opinions are common or desirable in society (Tankard and Paluck, 2016). Extreme weather experiences may also be interpreted through the lens of personal values, beliefs and political loyalties (Borick and Rabe, 2017; Capstick and Pidgeon, 2014; Cutler, 2015; Goebbert et al., 2012; Kahan, 2013). Values and beliefs typically bias experience appraisal in favour of personal intuitions and preferences (Bruine de Bruin et al., 2014; Capstick and Pidgeon, 2014; Howe and Leiserowitz, 2013), and political affiliation may embody norms that prescribe prototypical in-group attitudes and responses to key issues (Fielding and Hornsey, 2016).

For example, research in the UK indicates that the interpretation of cold weather as evidence for or against climate change is determined by individuals' level of scepticism about climate change, and climate change scepticism is in turn related to personal preferences for egalitarian versus individualist modes of social relations (Capstick and Pidgeon, 2014). According to the cultural theory of risk, egalitarians view nature as fragile and ephemeral, whereas, individualists perceive nature to be resilient (Steg and Sievers, 2000; Thompson, 2003). For this reason, egalitarians may see climate change as a danger requiring an active response and interpret unusually cold weather as confirming evidence of climate change risk, while individualists may see climate change as unproblematic and interpret unusually cold weather as evidence against climate change (Capstick and Pidgeon, 2014). Greater levels of climate change scepticism have also been linked with right-leaning political affiliation (Poortinga et al., 2011; Whitmarsh, 2011). This plausibly explains why extreme weather experience (specifically flooding experience) has been shown to be a weaker predictor of willingness to engage in climate change mitigation behaviour among right-leaning UK voters compared with their left-leaning counterparts (Ogunbode et al., 2017).

When people perceive themselves in terms of their ideological or political group membership, they assimilate to the group prototype and their attitudes and behaviours become regulated by the norms and standards associated with their group identity (Hogg and Reid, 2006; Rabinovich et al., 2012). Through this process, ideology and political affiliation can exert a powerful influence on how individuals perceive environmental conditions. In the United States, individuals with liberal values or left-leaning political affiliation show a greater tendency to report unusual changes in their local weather (Hamilton et al., 2016; Shao, 2016), and to perceive negative impacts from extreme weather (Cutler, 2015), than those with conservative values or right-leaning political affiliation. Further, perceived unusual weather changes and reported personal impacts from extreme weather are significantly associated with belief that climate change is happening now; a belief which is more commonly held by liberals than conservatives in the US (Bohr, 2017; Cutler, 2015; Howe and Leiserowitz, 2013; Shao, 2016). Accounting for differences in climate change belief tends to weaken statistical estimates of the relationship between political orientation and weather perception (Shao, 2016; Shao and Goidel, 2016), which suggests that the influence of political orientation on extreme weather perceptions may be mediated by climate change belief. The polarising influence of political/ideological group membership on weather perceptions and climate change attitudes may be further moderated by other social factors. US research shows that education contributes positively to divergence in climate change belief and the perceived likelihood of a future rise in extreme weather events among individuals with different ideological orientations (Hamilton et al., 2016), whereas, exposure to severe weather impacts are broadly associated with climate change threat perception among individuals at the lower end of the socioeconomic spectrum regardless of their ideological views (Cutler, 2016).

Two main points were distilled from these theoretical and empirical considerations to form the basis for the hypotheses tested in this study. Firstly, given a view of extreme weather attribution as encapsulating reflections on climate change risk and human responsibility, the attributability of extreme weather events to climate change may constitute a potential trigger for action by confirming the reality of the risks posed to society by climate change and affirming the agency of human action in precipitating and averting these risks. In other words, people may more strongly perceive a threat from climate change and feel a greater impulsion to act when they interpret their experiences with extreme weather to be attributable to climate change. Secondly, the subjective attribution of extreme weather experiences to climate change is likely to be influenced by individuals' personal and social context, especially their belief in climate change, political affiliation and perceived normative cues from salient actors. This means that: (1) pre-existing climate change belief may foster an implicit motivation to attribute extreme weather experiences in a manner that confirms personal intuitions and understanding, (2) the politicization of the public discourse around climate change may cause individuals to conform their subjective attribution of extreme weather events with political in-group views, and (3) the reactions of politicians, the media and other salient actors in individuals' immediate environment may influence subjective attribution of extreme weather by providing cues regarding popular and normative interpretations of an extreme weather event.

Thus, the following hypotheses were tested with respect to personal experience of the 2013/2014 UK winter flooding:

- (H1) Extreme weather experience has a stronger direct association with perceived threat from climate change among individuals who attribute their extreme weather experience to climate change, compared with those who do not.
- (H2) Through its moderating influence on the association between extreme weather experience and perceived threat, subjective attribution also moderates the indirect link between extreme weather experience and climate change-related behavioural intentions/policy support that is mediated by perceived threat. In other words, extreme weather experience is expected to inspire a greater level of motivation to act and to support climate change policies via its influence on perceived threat among people who attribute their experience to climate change compared with those who do not.
- (H3) Belief that climate change is happening is positively associated with subjective attribution of extreme weather experience to climate change.
- (H4) Affiliation with right-leaning political groups is negatively associated with subjective attribution of extreme weather experience to climate change.
- (H5) The reactions of institutional and socially-proximate actors e.g., politicians (H5a), the media (H5b), and acquaintances (H5c) regarding the attributability of extreme weather events to climate change is significantly linked with individuals' subjective attribution of their personal experience.

4. Method

4.1. Data

Data from a project entitled: '*Public perceptions of climate change and personal experience of flooding*' (Pidgeon et al., 2016) were used to test the hypotheses. The project was conducted by researchers at Cardiff

University and the University of Nottingham to assess public perceptions of climate change shortly after the 2013/2014 UK winter flooding. A survey was used to gather data in face-to-face interviews with a core nationally-representative British sample ($N = 1002$) and targeted oversampling of individuals in five flood-affected parts of the UK ($N = 995$) (Total $N = 1997$). See Capstick et al. (2015) for a detailed summary of the survey design and sampling procedure. The dataset is available within the UK Data Service catalogue.

4.2. Data analysis

Personal experience of the 2013/2014 UK flooding was broadly operationalised in this study to reflect direct experience of damage to own property, disruption of movement and access to essential services, damage to other property in local area, as well as experience of flood damage by friends and family. The decision to employ such a broad view of flooding experience was based on a consideration that the spatial coverage of flooding often means that affected individuals are exposed to direct, indirect, individual and collective adverse impacts (cf. Capstick et al., 2015; Demski et al., 2017). Further, the current operationalisation encompasses the range of flooding experience measures previously employed in the UK, including experience of flood damage to property (Demski et al., 2017; Whitmarsh, 2008), experience of flooding in local area (Spence et al., 2011), and combined experience of flood damage to property and experience of flooding in local area (Hamilton-Webb et al., 2016); which enables justifiable comparisons of findings from the current study with those from previous research.

Measures of flooding experience, attribution, perceived threat from climate change, climate change mitigation intentions, climate change policy support, climate change belief and perceived reactions of salient actors were derived from the dataset (Table 1). Responses gathered from residents in flood-affected areas were initially compared with those obtained from individuals comprising the nationally-representative sub-subsample (Supplementary Data T1a and T1b for full analysis). Respondents residing in flood-affected areas reported significantly greater experience of the 2013/2014 UK flooding on average than those in the nationally-representative sub-sample ($M_{flood\text{-}affected} = 0.40$, $SD_{flood\text{-}affected} = 0.28$; $M_{national} = 0.14$, $SD_{national} = 0.21$, $t_{(1830.83)} = -24.08$, $p < .001$). Conversely, respondents in the nationally-representative sample showed stronger indications that their acquaintances thought the floods were linked to climate change than those in flood-affected areas ($M_{flood\text{-}affected} = 3.40$, $SD_{flood\text{-}affected} = 0.98$; $M_{national} = 3.50$, $SD_{national} = 0.93$, $t_{(1848.58)} = -2.28$, $p = .023$). However, there were no significant sub-sample differences in any of the focal outcome variables.

Using stated voting intentions in a hypothetical general election, individuals who indicated an intention to vote for the 'British National Party (BNP)', 'UK Independent Party (UKIP)', or 'Conservatives' were categorised as right-leaning voters. The placement of these parties on the political spectrum was based on data from public polls conducted by YouGov in which people were asked to place each political party and themselves on a left-right scale ranging from "very left-wing" (-100) to "very right-wing" (+100) (Dahlgreen, 2014). Right-leaning voters were the focus in the current analyses (with the reference category being 'other' voters) because they may be more likely to conform with the norms of their political in-group (Panagopoulos and van der Linden, 2016). This focus also derives from a desire to further explore reasons why flooding experiences may have a weaker link with climate change mitigation responses among right-leaning UK voters (see Ogunbode et al., 2017).

Hypothesized direct relationships and interactions among constructs were tested in AMOS 22. Significant interactions were plotted with the web-based interActive tool (McCabe et al., 2018) and hypothesized moderated mediation effects were tested with the PROCESS macro for regression-based estimation of mediation, moderation and conditional processes (Hayes, 2014). Demographic factors (age, gender, social grade) were included as covariates all hypothesis tests and non-parametric bootstrapping with 1000 resamples was employed to ensure robustness of the estimates obtained. 'Don't Know' and 'Refused' responses in the dataset were coded as missing data. Three variables in the analyses had a relatively high proportion of missing data: perception of flooding to have been linked to climate change by politicians (13.1%), the media (9.3%) and acquaintances (7.1%), while others only had a small proportion of missing data (< 5%). The regression imputation function in AMOS 22 was used to impute the missing data. Descriptive statistics and reliability indices for the measured constructs are presented in Table 1. Zero-order intercorrelations among the constructs are provided as Supplementary Data (T2).

5. Results

5.1. Tests of hypotheses[2]

Flooding experience significantly predicted perceived threat from climate change (B = .28, SE = .07, $p < .001$, 95%CI: [.15, .42]), but not mitigation intentions or policy support (Fig. 1). As hypothesized (H1), there was a significant interaction between experience and attribution of the 2013/2014 UK flooding in predicting perceived threat from climate change (B = .19, SE = .08, $p = .017$, 95% CI: [.05, .35]). A breakdown of this interaction was conducted with the 'pick-a-point' and Johnson-Neyman techniques (Hayes and Matthes, 2009). The 'pick-a-point' approach involves selecting representative values (typically: 'high' = Mean + 1SD, 'moderate' = Mean, 'low' = Mean – 1SD) of a theorized moderator variable and then estimating the effect of the focal predictor at these values. Using this approach, personal experience of the 2013/2014 UK flooding was shown to be significantly associated with perceived threat from climate change at high (B = .45, SE = .09, $p < .001$, 95% CI: [.27, .63]) and moderate (B = .28, SE = .07, $p < .001$, 95% CI: [.15, .40]), but not low levels of subjective attribution (B = .10, SE = .10, $p = .284$, 95% CI: [-.08, .29]).

The Johnson-Neyman technique was used to estimate the range of subjective attribution values at which there was a significant link between flooding experience and perceived threat. This showed that personal experience of the 2013/2014 UK flooding was only significantly associated with perceived threat from climate change among individuals who had scores above the scale mid-point (≥ 3.02)[3] on the measure of subjective attribution ($B_{JN} = .16$, SE = .08, $p = .050$, 95% CI: [.00, .32]). In other words, flooding experience only predicted perceived threat from climate change among those who perceived the flooding to be attributable to climate change. The simple slopes relating flooding experience to perceived threat across the different values of subjective attribution are illustrated in Fig. 2. Roughly one-quarter (25.44%) of individuals in the total sample had subjective attribution values outside the range within which a significant link was observed between experience of the 2013/2014 UK flooding and perceived threat from climate change.

Moderated mediation analysis showed that perceived threat from climate change significantly mediated a positive indirect relationship between experience of the 2013/2014 UK flooding and mitigation intentions, as well as a positive indirect relationship between flooding experience and climate policy support, at moderate and high levels of subjective attribution (Table 2). However, as expected (H2), perceived threat did not significantly mediate an indirect link between flooding experience and either mitigation intentions or climate policy support at

[2] The tests of hypotheses were conducted using both list-wise deletion and regression imputation to replace missing values in the dataset. There were no substantive differences in the results obtained using either method. Hence, the results from the imputed dataset are reported here.

[3] Attribution values: Minimum = 1 (Strongly Disagree), Maximum = 5 (Strongly Agree), Mid-point = 3 (Neither Agree nor Disagree).

Table 1
Measures and items.

Construct	Items	M (SD)	Range	α
Experience of 2013/2014 winter flooding		.26 (.28)	1	.67
(0 = No, 1 = Yes)				
	Current or previous property affected by the floods	.08 (.27)	1	
	Experienced travel disruption or disruption to ability to work as a result of the floods	.35 (.48)	1	
	Experienced disruption of essential services such as gas, electricity, water supply, drains, telephone or internet as a result of the floods	.15 (.35)	1	
	Other people in local area experienced damage to their property from the floods	.42 (.49)	1	
	Friends and family directly affected by floods	.35 (.48)	1	
Subjective attribution		3.67 (.85)	4	.81
(1 = strongly disagree, 5 = strongly agree)				
	The floods were caused in part by climate change	3.60 (.96)	4	
	The floods were a sign that the impacts of climate change are happening now	3.66 (1.04)	4	
	The floods showed us what we can expect from climate change in the future	3.77 (1.00)	4	
Perceived threat		2.99 (.87)	4	.80
(1 = Not at all serious, 5 = Extremely serious)				
	How serious of a threat is climate change to you and your family?	2.79 (.97)	4	
	How serious of a threat is climate change to the UK as a whole?	3.20 (.92)	4	
Mitigation behavioural intentions		3.26 (.79)	4	.75
(1 = very unlikely to perform action, 5 = very likely to perform action)				
	Change to a 'green' energy supplier which would reduce the impact on the environment from the electricity you use in your home	3.29 (1.21)	4	
	Cut down the amount you travel by car	3.00 (1.30)	4	
	Buy appliances that are more energy-efficient	4.16 (.96)	4	
	Reduce the amount of energy you use at home	4.00 (.98)	4	
	Write letters, email, or phone your local MP about climate change	1.96 (1.14)	4	
	Sign a petition about climate change, either online or in person	3.16 (1.38)	4	
Mitigation policy support		3.30 (.93)	4	.66
(1 = strongly oppose, 5 = strongly support)				
	Road pricing schemes to reduce traffic in town and city centres	3.10 (1.30)	4	
	Tax increases to pay for more renewable energy	2.87 (1.25)	4	
	The UK signing up to international agreements to limit carbon emissions	3.95 (1.00)	4	
Climate change belief				
(0 = No, 1 = Yes)				
	As far as you know, do you think the world's climate is changing or not?	.94 (.24)	1	
Reaction of salient actors to 2013/2014 UK flooding				
(1 = strongly disagree, 5 = strongly agree)				
Politicians	Some politicians at the time linked the floods to climate change	3.66(.81)	4	
Media	Most media reports at the time linked the floods to climate change	3.47(.92)	4	
Acquaintances	People I know thought the floods were caused in part by climate change	3.45(.96)	4	

Note: Multi-item variables are represented in the analyses by the mean of their constituent items. Principal axis factor analysis with oblimin rotation was used to verify that each multi-item variable reflects a single underlying factor (see Supplementary Data T3).

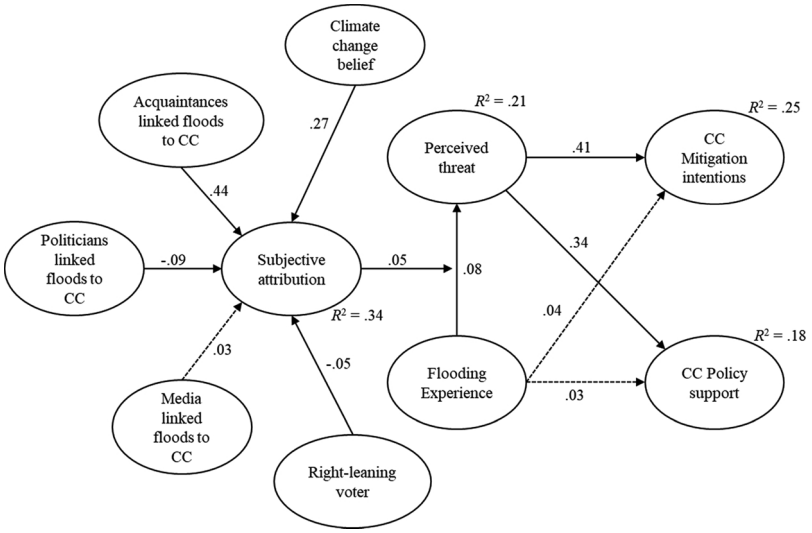

Fig. 1. Results of path analysis conducted with AMOS 22. Path coefficients are standardized betas. Solid paths indicate significant effects based on 95% bias-corrected bootstrap confidence intervals. Dashed paths are effects tested but found to be non-significant. The analysis controls for age, gender and social grade (N = 1997).

low levels of subjective attribution. The results of the moderated mediation analysis supports the notion that people are more likely to view climate change as a threat, and exhibit support for mitigation, following experiences with extreme weather events that are perceived to be attributable to climate change.

Finally, as hypothesized, subjective attribution was positively predicted by climate change belief (H3) and negatively predicted by right-leaning voting intention (H4). Participants who believed the flooding to have been linked to climate change by politicians were less likely to subjectively attribute the flooding to climate change (H5a). Whereas,

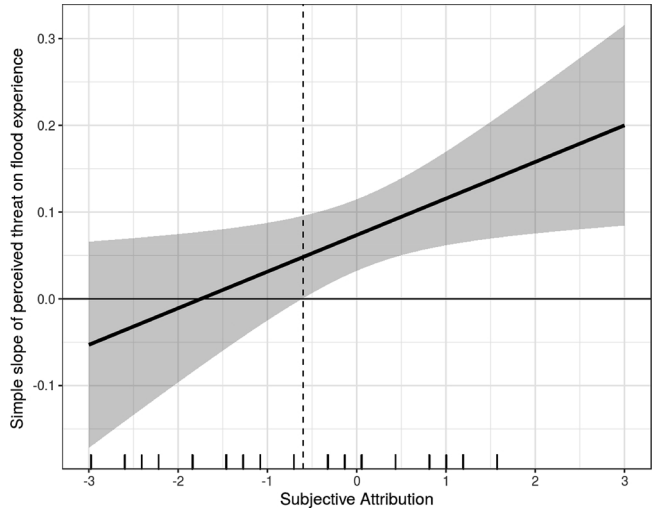

Fig. 2. Simple slope relating flooding experience to perceived threat from climate change. The association between flooding experience and perceived threat is significant and positive when subjective attribution is -0.65 standard deviations away from the mean or greater. 74.56% of subjective attribution scores were within this region. The vertical dashed lines indicates the level of subjective attribution at which the association between flooding experience and perceived threat becomes significant and the shaded area indicates the 95% confidence region.

Table 2
Tests of moderated mediation hypotheses.

Conditional indirect effects of flooding experience on mitigation intentions via perceived threat at subjective attribution value = Mean and Mean ± 1SD			
Mediator	Subjective attribution	B(SE)	95% CI
Perceived threat	−1SD	.037 (.038)	[-.042, .111]
	Mean	.100 (.025)	[.052, .150]
	+1SD	.164 (.035)	[.098, .236]
Index of moderated mediation		.072 (.031)	[.011, .134]
Conditional indirect effects of flooding experience on policy support at via perceived threat at subjective attribution value = Mean and Mean ± 1SD			
Mediator	Subjective attribution	B(SE)	95% CI
Perceived threat	−1SD	.035 (.036)	[-.037, .108]
	Mean	.096 (.025)	[.046, .145]
	+SD	.156 (.034)	[.087, .225]
Index of moderated mediation		.069 (.028)	[.017, .125]

Confidence intervals are bias-corrected and based on 1,000 resamples (Preacher and Hayes, 2008). The index of moderated mediation represents the slope of the line relating an indirect effect to values of a moderator (Hayes, 2015).

perceiving the flooding to have been linked to climate change by the media did not significantly predict subjective attribution (H5b), and belief that acquaintances thought the flooding was partly caused by climate change (H5c), positively predicted subjective attribution of the flooding to climate change (Fig. 1).

6. Discussion

It has been suggested that extreme weather events may provide an avenue for engaging the public with the growing risks posed by climate change (Demski et al., 2017; Wallace, 2012), but there has been limited investigation of how subjective attribution of extreme weather events may moderate the way extreme weather experiences affect climate change attitudes. Consequently, the current study explored the interaction between extreme weather experience and attribution in predicting climate change attitudes in the context of flooding and individual responses to climate change in the UK. The results show that personal experience of the 2013/2014 UK winter flooding was only significantly associated with perceived threat from climate change among individuals who subjectively attributed the flooding to climate change. Further, perceived threat only mediated a significant indirect relationship between flooding experience and climate change mitigation responses among those who subjectively attributed the flooding to climate change. These observations indicate that the potential of flooding experiences to engage individuals with climate change may be contingent on the rationalisation of flooding as a manifestation of climate change than with mere exposure to adverse impacts from flooding.

The link between flooding experience and climate change perceptions is often explained as a function of experiential processing (e.g., Demski et al., 2017; Taylor et al., 2014). In this regard, experiential processing is thought to reflect reliance on 'judgment heuristics', specifically: the *availability* heuristic - whereby flooding experiences presumably heighten perceived threat from climate change by increasing the ease with which salient weather changes come to mind, and the *affect* heuristic – whereby negative affective responses to flooding are intuitively associated with climate change. However, this explanation is limited by a neglect to account for differences in individuals' conscious rationalisation of their flooding experiences as indications of climate change risk. Given that climate change refers to long-term shifts in planetary weather patterns, any single extreme weather experience provides limited intuitive information about broader climatic trends (Egan and Mullin, 2012). Thus, individuals are likely to draw on the prescriptions of their values, beliefs and social preferences, and on normative cues (e.g., the perceptions and attitudes of key social referents), in determining appropriate interpretations of extreme weather with respect to climate change (Carmichael and Brulle, 2017; Kahan, 2013). In line with the experiential processing argument, experience of the 2013/2014 UK flooding predicted perceived threat from climate change and climate change mitigation responses among individuals who subjectively interpreted their experiences with the flooding as an indication of climate change, but the likelihood of interpreting one's flooding experiences in this way appears to be significantly influenced by climate change belief, political affiliation and the perceived reactions of other salient actors.

Unveiling nuances in the link between extreme weather experiences and climate change calls for greater emphasis of the psychological, political and social contexts in which extreme weather is subjectively interpreted with respect to climate change. Douglas (1985) indicated that the attribution of responsibility is shaped by the same biases that shape the social construction of risk. In a similar vein, the subjective attribution of extreme weather events to climate change is likely to be influenced by the same biases that shape broader perceptions of the reality and risk of climate change. Although personal experience of the 2013/2014 UK flooding positively predicted subjective attribution of the flooding to climate change, subjective attribution was more strongly predicted by climate change belief, and climate change belief had no significant association with flooding experience. Given a personal psychological context of pre-existing belief that climate change is occurring, it stands to reason that individuals may be inclined to confirm their preconceptions by rationalising unusual weather as evidence of climate change risk. In support of this view, the current study echoes previous indications that people often interpret their personal experiences with weather in the direction of their prior beliefs (Marlon et al., 2018; Myers et al., 2013).

This study also reiterates evidence of a link between political affiliation and climate change perceptions insofar that right-leaning voting intention was shown to negatively predict attribution of the 2013/2014 UK flooding to climate change. This finding is consistent with previous suggestions by Ogunbode et al. (2017) that flooding perceptions and associated responses to climate change in the UK covary systematically with individuals' political affiliation. Affiliation with the right-leaning Conservative Party has previously been linked with climate change scepticism (Whitmarsh, 2011), and political group identity can be expected to influence whether individuals perceive

relevant events to be unusual, unnatural and a reason to worry or act (Hahnel and Brosch, 2016; Shao and Goidel, 2016). Therefore, it seems plausible that right-leaning UK voters may be predisposed to reject a rationalisation of flooding as manifestation of climate change in conformity with the normative views that prevail within their political groups.

However, while modest correlations have been found between political ideology and climate change perceptions in the UK (McCright et al., 2016: online supplement), it is important to consider that climate change scepticism among right-leaning UK voters may not necessarily be rooted in personal endorsement of a right-wing ideological orientation, but may also lie with the affinity between possessing climate change-sceptic views and supporting the position(s) taken by right-leaning political parties on other key issues. For example, a perceived shift to the 'liberal consensus' on immigration and UK membership in the European Union by the Labour Party (categorised here as left-leaning) drove many of its supporters to defect to right-leaning parties with hard-line positions on these issues (Evans and Mellon, 2016). Defection in this instance was more evidently determined by the parties' policies than a large-scale change in voters' ideological orientation. This implies that voters across the ideological spectrum may be attracted to right-leaning parties' stances on specific issues and that these stances potentially coincide with climate change scepticism and de-emphasis of climate change risk. In this respect, shared views on key issues including climate change may form a broad basis for identification with right-leaning political parties or right-leaning parties' views on climate change may become a standard that shapes the climate change attitudes of members who are attracted by the parties' stance on other issues. There is a need for further research, however, to determine the extent to which ideological orientation can be disentangled from party affiliation in predicting climate change attitudes in the UK.

Another important result obtained in this study pertains to the pattern in which subjective attribution was predicted by belief that politicians, the media or acquaintances linked the floods to climate change. Previous research in the US indicates that political cues and media coverage play a positive role in driving public concern about climate change (Carmichael and Brulle, 2017). In contrast, perceived political cues negatively predicted subjective attribution of the 2013/2014 UK flooding to climate change. Some of the comments left by participants[4] in the study are instructive in understanding the interpretive landscape within which politicians' statements on the flooding may have been received. For example, a participant wrote: "*Climate change has been hijacked by politicians to make money….*" [Male, 65–74, Conservative, Sunbury to Windsor], while another opined: "*They [politicians] are jumping on the bandwagon to excuse themselves for not doing flood prevention*" [Female, 65–74, Dawlish]. These comments reflect the widely publicised public mistrust of UK politicians' reactions to the floods (Cologna et al., 2017), and suggest that the negative relationship observed between political cues and subjective attribution may be the result of perceived politicians' lack of credibility in the context of the flooding. Similarly, in contrast to indications by Cologna et al. (2017) that media reporting plays an active role in shaping public responses to flood risks, the perception that media reports linked the 2013/2014 flooding to climate change did not significantly predict individuals' subjective attribution of the event. However, belief that acquaintances perceived the flooding to have been caused by climate change was a positive predictor of subjective attribution. People often look to others for guidance on appropriate responses to situations that are perceived to be uncertain or ambiguous and the likelihood of conforming our responses to that of other individuals depends on their social proximity and perceived similarity (Cialdini, 2001; Lapinski and Rimal, 2005). Consequently, it comes as no surprise to see that the perceived beliefs of family, friends and other people with whom individuals share a personal connection appear to be more closely linked to subjective interpretations of a seemingly ambiguous weather event than indications made by comparatively socially-distal political and media figures.

Most individuals (74.56%) in this analysis subjectively attributed the 2013/2014 UK flooding to climate change to a level at which a positive link was observed between flooding experience and perceived threat from climate change, as well as an indirect link between flooding experience and climate change mitigation responses. However, among a minority who did not perceive the flooding to be attributable to climate change, flooding experience had no significant link with perceived threat from climate change or climate change mitigation responses. The interpretation of extreme weather experiences among the public is highly subjective and variable because experience is socially constructed and the linkages between extreme weather events and climate change are often difficult to establish (Marlon et al., 2018). As indicated by Weber (2010), personal experience alone is not a panacea and concern can only result from experiences of adverse impacts that are seen to be connected to the phenomenon whose perceived severity and likelihood is being studied. This means that local weather experiences are unlikely to inspire and sustain positive climate change engagement unless people clearly connect the dots between climate change and extreme weather impacts (Knowles, 2017; Palm et al., 2017). Thus, the subjective attribution of extreme weather events and the shaping influence of the contexts in which subjective attribution occurs are as critical to driving public engagement with climate change, and as deserving of scholarly interest and investigation, as extreme weather experiences.

The interaction between flooding experience and attribution in this study suggests that, within a given population sample, the likelihood of observing a significant link between extreme weather experience and climate change attitudes may depend on the distribution of individual differences in the subjective attribution of the extreme weather event(s) to climate change; a factor which plausibly explains the mixed evidence previously observed for a link between flooding experiences and climate change attitudes in the UK. It also prompts consideration of how this distribution may be affected by limitations in popular approaches to assessing the effects of extreme weather experiences. Scholarly interest in the link between extreme weather experiences and climate change attitudes is premised on evidence of plausible connections between extreme weather and climate change, the *probability* that members of the public recognise these connections and a presumption that recognising these connections constitutes a compelling reason to act on climate change. Brushing over the heterogeneity of public opinion on the attributability of extreme weather to climate change in a bid to establish the third element of this premise raises the risk of producing results that spuriously support researchers' presuppositions.

For instance, many individuals were keen to state their belief that factors other than climate change contributed to the 2013/2014 UK winter flooding in open-ended comments collected in the current study. In line with prior research (Whitmarsh, 2008), some of the most common factors mentioned were poor watercourse management and a lack of investment in flood defences. The level of emphasis of these other contributing factors would suggest that they were perceived to be more intuitive causal elements in the 2013/2014 UK flooding than climate change. Indeed, participants may only have been prompted to consider the potential causal role of climate change in the flooding when presented with the questionnaire. In the words of one respondent: "*a lot of* [the] *questions were assuming that the flooding was due to climate change*" [Male, 45–54, Conservative, Sunbury to Windsor]. Another observed: "*some questions leading from a partic[ular] standpoint and not independent. Too many narrow questions for wide issues*" [Male, 35–44, Gloucester to Tewkesbury], and a third wrote: "*some questions expected simple answers for very complex issues*" [Male, 45–54, Liberal Democrat]. These comments suggest that, among a fraction of participants at least, the framing of the survey items was perceived to be leading or

[4] The comments cited here were left by participants residing in areas affected by the floods.

constrictive. The perceived framing of the survey questions could have distorted participants' responses by triggering acquiescence or reactance; meaning that the data likely reflect framing effects in addition to participants' natural judgments of the connection between the flooding and climate change. Such comments have not been presented in other reports on this topic, but potential distortion of participant responses by framing effects is unlikely to be unique to the current study.

It has previously been observed that the relationship between personal experience and climate change perceptions is methodologically difficult to untangle (Demski et al., 2017), and there remains a need to back up current evidence of the potential of extreme weather experiences to foster climate change engagement with robust approaches that allow for a richer representation of the subjective interpretation of extreme weather events among various publics. Further, while the core hypothesis of this article regarding the interaction between extreme weather experience and subjective attribution was supported in the context of flooding experience and perceived threat from climate change, the estimated effect of the interaction is modest. Therefore, replications of the current findings among other populations and in relation to experiences of other forms of extreme weather are needed to lend further credence to the arguments presented in this article.

7. Conclusion

The current findings support prior indications that the subjective attribution of extreme weather events to climate change moderates the translation of extreme weather experiences into climate change mitigation responses (Givens, 2014; McCright et al., 2014). They also indicate that subjective attribution may be socially constructed on the bases of pre-existing climate change belief, political loyalties and perceived normative cues. Current developments in climate science portend increasingly robust assessments of the contribution made by climate change to specific weather events (Stott et al., 2016), and public engagement efforts could be significantly aided by placing scientific evidence of the connection between extreme weather and climate change, where available, at the fore of climate change communication (Messling et al., 2015). However, substantive effort must also be directed at engaging the psychological and social contexts that shape individuals' willingness to recognize and act on this connection, with a view to enabling appropriate responding across the broad spectrum of society.

Acknowledgements

This research was supported by the UK Economic and Social Research Council (grant ES/M005135/1), the Climate Change Consortium of Wales, and the Cardiff Sustainable Places Research Institute.

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